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Date: April 23, 2009

To: The Surface Transportation Board
c/o Timothy Strafford

Re: Notice of Public Hearing: STB Ex Parte No. 431 (Sub No. 3) "REVIEW OF THE SURFACE TRANSPORTATION BOARD'S GENERAL COSTING SYSTEM"

Dear Mr. Strafford:

I hereby submit my intent to submit both oral and written testimony concerning the Board General Costing System. Attached below are my personal qualifications and written comments. In general, these comments discuss the treatment of investment costs in the calculation of variable costs and highlight other issues related to the finding that railroad capital spending is generally variable with output.

I would like the opportunity to submit oral comments before the Board during the hearing on the 30th of April and request 15 minutes to make such oral comments.

Sincerely,

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COMMENTS ON THE STB'S GENERAL COSTING SYSTEM

My name is George Avery Grimes. I hold a doctorate from the University of Illinois at Urbana-Champaign Department of Civil Engineering (2004) for research in railroad engineering, economics and finance. I am also a graduate of University of Nebraska Graduate College of Engineering (MSCE, 1994) and University of Illinois (BSCE, Railroad Engineering, 1978).

I am an Operating Partner with CIH Capital Partners, a strategic advisory firm and private equity sponsor group that specializes in the rail sector. Prior to my current position I was Senior Vice President for a short line railroad holding company. I have held various positions with transportation companies for nearly 34 years, principally in the railroad industry. My responsibilities have been broad, including transportation planning, engineering, finance, environmental operations and emergency response, marketing, business development and strategic planning. I have been a licensed locomotive engineer and have operated both road and switch locomotives in freight service.

I am a registered Professional Engineer in the states of Missouri and Washington, serve on the Transportation Research Board's Committee on Freight Rail Transportation (AR040) and am a member of the American Railway Engineering and Maintenance Association (AREMA). I have published refereed papers that required extensive statistical analysis of railroad operations, engineering and capital investment.

Particularly relevant to the comments in this statement, from 2002 through 2004, I engaged in doctoral level studies at the University of Illinois with a particular focus on the hypothesis that railroad capital expenditures represent an incremental cost of traffic that was substantially underestimated in industry and regulatory calculations of incremental cost. My doctoral committee included professors from three departments (Engineering, Economics and Finance) and my studies included graduate level courses in statistics, econometrics, economics, finance and engineering. The dissertation, "Recovering Capital Expenditures: The Railway Industry Paradox" is published at the University of Illinois at Urbana-Champaign.

Overview

One of the findings of my research was that, from 1988 to 2002, changes in annual railroad infrastructure investment were largely variable with and caused by current and anticipated changes in annual output (as measured by Gross Ton Miles). In aggregate, almost ninety percent of these costs were variable with output on an annual basis. Annual investment is principally forward looking, determined by current and future output, and not by past output. As a result, most capital expenditures and related investment costs should be considered in short- or near-run variable cost estimates.

Based on my experience in the rail industry and my training as a railway engineer, these results were not surprising. The old engineering question, "Does it wear out or does it rot out?" has substantially shifted to wearing out with usage. As tonnage densities increase and railcars become heavier, the increasing stress state of these components causes them to wear at ever faster rates. Faster wear means that capital spending to replace and upgrade these components has become increasingly variable with rail output over time. I updated my analysis with data through 2007 for Class I railroads and found even higher levels of average variability and significance. It is reasonable to expect that the degree of variability will continue to rise with greater densities and higher stresses.

The STB's Uniform Railroad Costing System (URCS) incorporates a default factor of fifty percent variability (for infrastructure) for both depreciation and investment opportunity cost (ROI) based on original studies conducted by the ICC in the late 1930's. This method is flawed in two respects: (1) the variability factor is too low, and (2) depreciation based on historic values is an incorrect and inadequate surrogate for actual capital spending. The incorporation of opportunity cost is correct and necessary to attract capital. Should the Board consider revisions to URCS, it should also revise the original RFA default variables for infrastructure investment that were imbedded within URCS.

Another important implication of this research is that as capital spending becomes increasingly variable with output over time, railroad rates (prices) and ongoing rail investment become more closely and directly linked than previously thought using the standard neo-classical model of investment. To the extent that rail prices are constrained, ongoing investment will also be constrained in order to maintain financial viability of these firms.

Literature survey

Lorenz (1915, 218) believed that both operating costs and capital costs were variable with traffic. Miller (1925) found that, from 1902 to 1923, property investment was 74% variable with traffic volume. Healy (1940, 197) expressed the view that over a wide range of densities, the costs of handling additional increments of business were not likely to be much below average costs. Daggett (1941, 314-19) believed that capital investment was variable in both expansion and contraction of railroad business. Starkie (1982) connected engineering practice and economic theory and disputed the traditional assumption that transportation capacity is subject to pronounced lumpiness or indivisibilities.

Gomez-Ibanez (1999) warned "[Railroad] capacity (may) be less lumpy, and sunk costs smaller than they first appear, with the result that short-run marginal cost may not be so different from long-run marginal cost ... Beware of arguments that marginal costs are very different from average costs." Ivaldi and McCullough (2001) proposed that infrastructure capital played a significant role in explaining variable costs, and used renewal expenditures, which comprise the majority of infrastructure investment, in their estimates of variable cost. Haley (2003, II-54-55) argued that railroads calibrate their capital expenditures to accommodate incremental traffic through incremental capacity improvements. Grimes and Barkan (2006) found that railroad maintenance strategies that place more emphasis on (capitalized) renewal programs result in lower unit maintenance costs and explained that, from an engineering viewpoint, capital spending and ordinary expense were merely two sides of the same (infrastructure resource) coin.

Engineering foundations of Variable Capital Investment theory

Investments in transportation infrastructure have traditionally been considered to come in large or "lumpy" increments (Starkie 1982). Examples include a new lane for a highway or a second main line or yard for a railway. Although relatively small projects can easily be viewed as variable with output, it is the big lumpy projects that lead to a common misinterpretation of the actual degree of variability of capital expenditures for infrastructure.

Although individual capacity projects are often considerable in size and scale, they typically represent a relatively small portion of the overall capital budget. Even large projects normally represent only a small portion of the overall capital budget. Furthermore, such projects are initially a fraction of their ultimate size and are designed to grow incrementally with demand. For example, a new intermodal yard may cost as much as $200 million, but the initial capacity may be only a fraction of the ultimate design capacity. As demand grows, tracks, parking space and facilities are added in smaller increments.

Engineering studies support the concept that capacity can be added in small or variable increments as demand changes. Starkie (1982) demonstrated that highway capacity could be added in small increments, finding that although the number of lanes was normally used to estimate capacity, there were many other factors that should be considered. These include lane width, clearance from obstructions, shoulder level, horizontal and vertical alignment, auxiliary lanes, surface quality, and traffic control systems. Such features could be added incrementally to match capacity to demand.

Similarly, railway capacity and investment can be judiciously adjusted to match demand. Siding spacing, number of locomotives, train size distribution, train crew availability, signaling systems, dispatching policies, management of slow orders and distribution of train speeds can all be employed to incrementally expand or contract capacity to a predetermined level. Lengthening or shortening the time horizon between renewal programs can also gradually expand or contract infrastructure capacity and investment. Railway engineers often use the term "fit for purpose" as their engineering objective which means they continually adjust the level of investment to changes in the demand. There are many options to adjust the level of capacity of and investment in even a single route to the point where it matches demand, and large networks have even more options to fine-tune overall capacity and investment to complement overall demand.

Furthermore, the concept that railroad assets are generally "long lived" has little or no influence on whether they should be considered "fixed" or "variable" for economic considerations. [1]

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[1] In most instances, the classification of an asset is based on the quantity ("Unit of Property") used in a particular project. For example, a cross-tie may be classified as either operating or capital depending on the

Research methods

Industry financial data were consolidated and normalized on a constant year (2001) basis. The elasticity of infrastructure capital expenditures on a year-to-year basis was estimated. OLS regression estimates were obtained for each railroad and the coefficient significance was evaluated along with the sign and absolute value of the variable coefficients. Lag specification tests determined (1) if lags were influential, and, (2) which lags were significant and would be included in causality tests. Vector auto regression (VAR) Granger causality tests were used to evaluate whether one variable influences or "causes" change in another variable by determining whether lagged information on one variable had any statistically significant role in explaining the other variable. Variables included in lag and causality tests included infrastructure capital expenditures, output as measured by gross ton miles, free cash flow and net income.

The standard neo-classical economic theory of investment specifies that investments are made to maximize the expected new present value of thc incremental revenue stream from the investment. But this generic model of investment does not explain how a complex corporation composed of competing specialized interests identifies investment opportunities and forms expectations about net returns. Hall et al. (1998) applied VAR causality tests to analyze how corporate structures influence investment decisions. I used similar causality tests to determine if investment in railroad infrastructure was for long-term capacity growth or a short-run response to current and anticipated changes in service demand.

Because of significant consolidations in the railroad industry (from 36 Class I Railroads in 1978 to 8 in 2001), cost and output data were combined into railroad groups representing the 2001 industry structure consisting of 8 railroads: UP, BNSF, CSX, NS, KCS, IC, SOO and GTW. Investment, Net Income and Free Cash Flow cost data were derived from the AAR Analysis of Class I Railroads (AAR 1988-2002) and then normalized to 2001 using the Producer Price Index.

size of the overall project. The classification as expense or investment is not influenced by the estimated life of that component, but rather by the engineering maintenance strategy used to employ that asset.

Results

The elasticity of infrastructure capital expenditures for the period 1988 through 2002 was found to be 88% with a high degree of significance ($p = 0.0000$).[2] The model tested was:

$$\ln(RI) = a + [b \ln(GTM)] + \varepsilon$$

where: RI = Infrastructure capital expenditures

a = Intercept

b = Coefficient for ln(GTM), elasticity

GTM = Gross Ton Miles

ε = error term

A Granger causality test confirmed that "output (GTM) granger causes capital investment" with a high degree of significance ($p = 0.0000$). The models tested were:

$$RI_t = RI_{-1} + RI_{-2} + RI_{-3} + GTM_{+1} + GTM_t + GTM_{-1} + GTM_{-2} + \text{firm} + \varepsilon$$
$$RI_t = RI_{-1} + RI_{-2} + RI_{-3} + \text{firm} + \varepsilon$$

where: RI_t:RI_{-3} = Infrastructure capital expenditures in years t though t-3 [3]

GTM_{+1} = Gross Ton Miles in year t+1

GTM_t:GTM_{-2} = Gross Ton Miles years t through t-2

firm = dummy variable for each railroad

A logical explanation for these results is that demand in both the current year and in the near future was anticipated and included in railroad investment plans. This would suggest that overall infrastructure capital spending was determined by senior management on the basis of current and anticipated near term demand for railroad services. Although engineering departments may allocate renewal capital funds partly on

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[2] For the period 1988 through 2007, the average variability was 110% ($p = 3.6E-09$)

[3] Numerical subscripts on the variables indicate the lag period relative to the base year (t). For example, if RI_t represents capital expenditures in 2002, then RI_{-5} represents capital expenditures in 1997.

the basis of past wear and tear, it appears that the overall capital budget was determined (or caused) by current and anticipated output.

Additional Granger causality tests were conducted to determine if net income and/or free cash flow could be potential 'causes' of capital expenditures. The results of these tests did not cause me to question the previous finding that infrastructure investment was caused by output. In fact, infrastructure investment was found to be a more reliable determinant of free cash flow and net income (than output), and output was the primary causal determinant of capital expenditures.

Causality estimation was also conducted using vector auto regression (VAR). The VAR method used was a Granger Causality Wald Test and significance was tested using chi-squared tests. [4] These tests found that current and/or future output (i.e., GTM_t and/or GTM_{+1}) caused current infrastructure investment (RI_t) for US Class I railroads (in aggregate) and for UP, BNSF, CSX, NS, SOO, and GTW at a 95% (or greater) level of confidence. In summary, these tests confirmed that current and anticipated changes in output were the primary determinants of current infrastructure capital spending.

From an economic viewpoint, these results suggest that infrastructure capital expenditures are variable with and caused by output, and therefore should be included in variable cost estimates. The degree of variability was not uniform among railroads, but in aggregate, the data indicate that most of these expenditures are variable within a one-year time horizon. This conclusion was further supported by lag test results that indicated annual capital spending was related to current and future output (and not past output), and confirmed the fairly short-run relationship between output and ongoing investment.

Regulatory treatment of investment costs

In 1939 the ICC's Section on Cost Finding, led by Ford Edwards, developed Rail Form A (RFA) to provide a uniform method to estimate rail costs for rate regulation (ICC 1939; ICC 1943). In estimating "average variable cost," Edwards included the variable portion of operating expenses, rents and taxes. To account for infrastructure investment

[4] In these tests, statistical significance is evidence of causality. Statistical Analysis Software (SAS 2003) was used for this analysis.

in "average variable cost," he somewhat arbitrarily assumed that 50% of infrastructure was variable with output and incorporated 50% of infrastructure depreciation expense. He recognized that 'fair return' should be also be included in these calculations and applied the 50% variability factor for Return on Investment (ROI) on infrastructure investment to account for opportunity costs. [5]

The theory that fair return on investment should be included in regulatory variable cost estimates had been established previously. Merritt (1906, 16) stated that fair return on investment was required for future investment, "for if investors were to be deprived of the privilege of earning such returns, there would never be another mile of railway built in this country, which in the present state of our economy would be disastrous." Edwards (1934, 155) asserted that the cost of service, for regulatory purposes, included the cost of operating the plant plus a fair return on the fair value of the property. Locklin (1935, 130-31) pointed out that the cost of future capital depended on a return to capital: "... capital must in the long run receive its reward, or additional capital will not be forthcoming when needed."

The ICC (1980, 35) explained the social desirability for including ROI in regulatory cost formulae that echoed the "reward" philosophy espoused by the economists. "Failure to consider new investment in facilities used to service captive shippers would be inconsistent with our responsibility to encourage useful and socially desirable investment by the railroads. Movement specific investments must be *rewarded* if additional investments are to be encouraged" (emphasis added).

From an engineering economics viewpoint, the inclusion of fair return in regulatory cost calculations (for maximum rate regulation) is necessary to maintain rational economic behavior on the part of the regulated entity. To illustrate, suppose there is a railroad where all prices are regulated by a fixed revenue-to-variable cost ratio.

[5] Edward's original (1939) estimate of investment variability was derived from earlier industry data (1915-1932) that showed that total (infrastructure and rolling stock) annual investment was between 65% and 200% variable with traffic volume. Most if not all of the data he relied on did not segregate infrastructure and rolling stock capital. Accordingly, he assumed that rolling stock investment was 100% variable and decided that aggregate infrastructure investment "should be about 50% variable" (ICC 1941). This percentage (50%) was applied to (1) the ROI portion for aggregate infrastructure investment and (2) to infrastructure depreciation expense, both of which were then included in the calculation of RFA's "average variable cost."

Also suppose that this railroad is considering whether to make a one-time investment that has a net present value less than the net present value of the avoided maintenance costs. The railroad's engineers would choose to make the investment only if a fair return (on the entire investment) was included in the (regulatory) variable cost calculation, because otherwise rates would be adjusted downward (as a result of a reduction in variable operating expenses) making the investment uneconomical. In this manner, the inclusion of fair return in the regulatory cost base is consistent with rational economic behavior on the part of the regulated entity. As illustrated in the above example, the fair return calculation should be applied to all investment - fixed or variable - necessary for production if rational investment behavior is to be preserved.

The use of depreciation as a surrogate for actual capital spending is clearly flawed. In commenting on cost calculations used for regulation, Alfred E. Kahn (1970, 73) stated,

> ... even to the extent that depreciation does vary with use, what belongs in the marginal cost calculation is not the book cost, the writing off of investment cost historically incurred, but the amount by which this and other capital costs will be higher than they would otherwise be in the future by virtue of the incremental production in question.

Wilson (1980) supported this viewpoint. "Kahn is therefore correct as long as we remember that economic costs are prospective, not historical, and that if a shipment is to be repeated, all future costs associated with the prospective traffic need to be added. These costs not only include the variable costs of labor, fuel, etc., but also the variable capital inputs associated with the traffic."

Wilson's and Kahn's remarks emphasize the need to earn a return or opportunity cost on a replacement cost basis. This is consistent with my more recent experience in the short line railroad industry. If a rail property cannot earn a return on the replacement cost of its infrastructure, as it is gradually worn out less and less of the overall investment will be replaced, and available operating cash flow (if any) will increasingly be directed to investments with better risk-adjusted returns.

Implications for regulatory cost formulae, railroad pricing and investment

The RFA average variable cost formulae developed in 1939 appear to have been deficient in at least two important aspects with respect to investment and capital expenditures. First, inclusion of a return on investment in cost estimates is appropriate, but should have been calculated on most, if not all, of the infrastructure investment base. Second, depreciation expense based on historic values is an incorrect and insufficient surrogate for ongoing investment expenditures. Variable capital expenditures are a substantial portion of short- or near-run variable costs that should be included in variable cost formulae. Depreciation techniques may serve as a convenient method to smooth out annual variation in capital spending, but if used in this way, they must equal total variable capital expenditures over a relatively short time horizon.

The ICC revisited its original 1939 study several times (ICC 1948; ICC 1954; ICC 1963) but did not reconsider its approach to investment costs. Following deregulation, these flaws were magnified in their effect because railroad betterment accounting for track structure had been replaced by depreciation accounting in 1983 that reclassified substantial portions of operating expense ("replacements") as capital investment. [6] Over time, these flaws continued to grow in magnitude (1) as rail engineering methods became increasingly reliant on capital intensive methods and (2) as tonnage densities increased.

The ICC imbedded these conceptual deficiencies in the development of URCS even though it corrected many other flaws inherent in RFA. As a result, URCS average variable cost estimates are similarly flawed.

The presence of highly variable capital spending also suggests that railroad rates (prices) and rail investment are far more closely and directly linked than previously thought using the standard neo-classical model of investment. To the extent that prices are constrained, then investment must also be constrained or railroads will face increasing threats to their financial viability.

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[6] Depreciation accounting procedures, implemented in 1983, significantly altered the definition of operating expenses and capital expenditures. The aggregate industry effect of these changes was estimated to increase reported net income by approximately 34% (US GAO 1982)

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